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# NASA TECH BRIEF

*Lewis Research Center*



## Calculation Procedure for Transient Heat Transfer to a Cooled Plate in a Heated Stream Whose Temperature Varies Arbitrarily with Time

The surface temperature and surface heat flux for a cooled flat plate when the fluid passing over it has a temperature at the plate leading edge that varies arbitrarily with time can now be found by using newly developed heat transfer equations.

The equations have many practical applications. The flat plate can be a rocket motor during startup, a nuclear reactor component, a recuperative heat exchanger during startup and shutdown, or gas turbine blades and vanes during startup, shutdown, or changes in the steady-state power level of an already operating engine.

The equations were developed by starting with the specific solutions for the case when the fluid temperature at the plate leading edge varies linearly with time between two specified temperatures. The solution to the linear case was then generalized and served as the basis for the case when the fluid temperature varied arbitrarily with time. For this latter case, the actual fluid temperature variation at the plate leading edge was approximated by a sequence of ramps or steps.

Notes:

1. These equations are described and their use demonstrated by examples in the following report:
   NASA TM-X-3238 (N75-25095), Calculation Procedure for Transient Heat Transfer to a Cooled Plate in a Heated Stream Whose Temperature Varies Arbitrarily with Time
   Copies may be obtained at cost from:
   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B75-10244
2. Specific technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B75-10244

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